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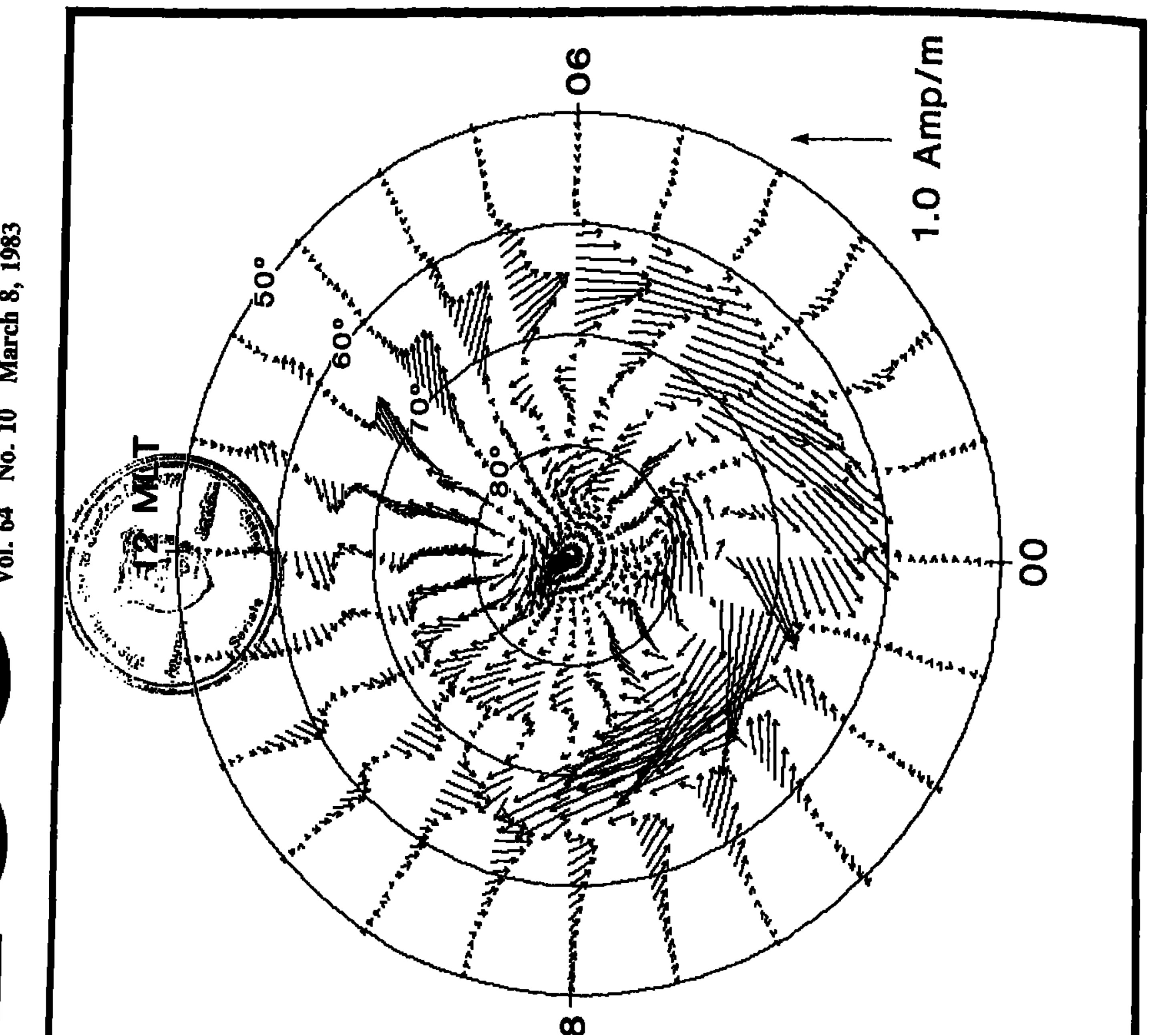

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News

Mount Erebus Activity

An international team of scientists reports that unusually high seismic activity joggled Mount Erebus last fall. However, the Antarctic volcano showed no external signs of an eruption.

When scientists from the United States, Japan, and New Zealand returned to the world's southernmost active volcano last November for their annual field expedition, they found that seismic stations recorded 650 small tremors on October 8; prior to that, the number of quakes had averaged between 20 and 80 per day. The October 8 maximum was followed by 140 on October 9 and 120 on October 10. Philip R. Kyle, assistant professor of geochemistry at the New Mexico Institute of Mining and Technology in Socorro and leader of the team studying Mount Erebus, noted that some of the strongest earthquakes recorded during the team's 3 years of observations occurred on October 8; these registered less than 2 on the Richter scale.

The quakes at the 3800-m volcano were caused by magma moving within the earth, similar to the mechanisms recently jarring the Mammoth Lakes area in California (*Eos*, August 3, 1982, p. 593, and June 29, 1982, p. 553), according to Kyle, who recently filed the team's report with the National Science Foundation (NSF). (NSF funds and coordinates all U.S. activities in Antarctica.) Kyle stressed that there is little, if any, chance that the volcano would erupt. Unlike Mount St. Helens, there is no pressure being built up in Erebus, which is in a state of hydrostatic equilibrium, he said.

Erebus' crater is a lava lake of molten rock 90 m in diameter. One of the world's two active lava lakes, the lake is believed to be the top of the volcano's magma chamber, a storage area for hot molten rock within the mountain, according to NSF. During the fall expedition, the scientific team noticed that in 1 year the lake level had fallen by 3 m and had lost 8500 m^3 of lava. The team speculates that the magma forced itself into a crack in the volcano and spread out to form a dike. The possible location of the dike is unknown, however. A more detailed report will appear in an upcoming issue of the *SEAN Bulletin*.

Meteorite Samples

The more than 5,000 meteorite samples recovered from the Antarctic ice sheet since 1969 are available for study, it was recently announced. The samples, which include rare types and fragments suspected to originate from sources other than the asteroid belt, were collected with support from the National Science Foundation (NSF) and are curated in a joint program of NSF, the National Aeronautics and Space Administration, and the Smithsonian Institution.

Send your request for samples to the Secretary, Meteorite Working Group, Curator's Branch, SN2, NASA, Johnson Space Center, Houston, TX 77058. A newsletter, workshop report, and additional information may be obtained without charge from the Lunar and Planetary Institute at the same address. Catalogs on the meteorites are available, also at no charge, from the Department of Mineral Sciences, National Museum of Natural History, Mail Stop 119, Smithsonian Institution, Washington, DC 20560.

Seabed Mining Law in Turmoil

When it was realized last December that the United States would not sign the United Nations (U.N.) Law of the Sea Convention, it was suspected that the issue of deep seabed mining was a preeminent factor. According to a recent discussion by members of the Marine Resources Project of the University of Manchester, U. K. (*New Sci.*, January 1983), the thinking of many national delegations was focused on the aspects of ocean-floor nodule mining. The United States would rather make less sweeping agreements, limited to those countries that already have deep-sea mining investments. Such an agreement has been made on an interim basis between the United States, France, West Germany, and the United Kingdom. Third World nations, on the other hand, have a vested interest in having the convention signed, because they would share in the profits.

There are 2 years left during which nations may sign the convention, but how the rules of deep seabed mining will be decided could be influenced before then. The worry is that rival groups of the signers and the nonsigners could endanger the nodule mining industry as well as the oceans.

The third U.N. Conference on the Law of the Sea (UNCLOS) ended what had been almost 10 years of deliberations by the 119 national delegations. The main objective of the conference was to offset the development of the oceans and to protect them. There had been, as a part of the overall effort, a strong movement to transfer some of the wealth gained from the mining of nodules to Third World nations. The convention set up the International Seabed Authority (ISA) which is to take steps to compete with mining companies. According to the University of Manchester report, 'Private companies would, among other things, have to agree to provide the Enterprise (the operating arm of ISA) with fully prospected sites and sell it technology if they want to obtain mining licenses from ISA. . . . There is no doubt that the convention offers far from ideal terms for private companies contemplating nodule-mining.' The United States did not find this part of the convention workable. The bureaucracy of the system would be unmanageable, and such a convention could have far reaching implications in the future for the international regulation of other resources.

The status quo is one of confusion. Nations appear to have lost sight of the main provisions of the UNCLOs convention. Third World nations are looking forward to sharing a piece of the wealth and the high technology. The western-nation delegations, particularly the United States and Great Britain, are not signing the convention yet or at all, and the United States is lobbying to support others not to sign. The nature of the convention is that amendments that may appeal to western delegations cannot be made now.

The Marine Resources Project at Manchester notes that if Britain or other deep-sea mining countries are to affect the outcome, they must sign the convention. The next step in the process is to set the rules that will implement the provisions of the convention. Implementation is to begin in Jamaica this March by PREPCOM, the Preparatory Commission for the ISA and by the International Tribunal for the Law of the Sea. It is thought that a number of the important decisions could be made by PREPCOM when it meets.

The potential economic consequences of the circumstances are severe. If an unstable, fragmented regulatory system results from the present deliberations, deep seabed mining companies may end up with huge legal disputes in the International Court of Justice. The governing body could possibly rule out all seafloor mining activity for an indefinite period. The ISA itself needs contributed funds from the wealthy nations to be able to operate; but even without the necessary funding, it would appear possible to delay or prohibit mining operations.—*PMB*

New Hydrology Program Set

A hydrology program leading to a bachelor of science in hydrology will begin this fall at Tarleton State University, a part of the Texas A&M University system. The 4-year program aims to prepare students for entry-level positions leading to professional, hydrology-related careers and for appropriate graduate academic programs.

Included in the program's core curriculum are courses in calculus, statistics, chemistry, biology, physics, geology, soil science, computer science, and water-related courses in mechanics, hydraulics, hydrology, groundwater, water treatment, water quality, and water resource management. The program will be guided by a director in conjunction with an external advisory board of professionals knowledgeable about and concerned with the responsible use and management of water resources.

For additional information, contact T. C. Hinkson, Head, Department of Physical Sciences, Tarleton State University, Box T-69, Tarleton Station, Stephenville, TX 76402.

Field Research Support

The Center for Field Research is seeking research projects eligible for support by Earthwatch. Earthwatch is a private, volunteer research corps that enables qualified members of the public to join research expeditions both as coworkers and as patrons helping to underwrite expedition costs. To qualify for selection by the center, projects must be designed to make effective use of nonspecialists in field assignments.

Each year, the center selects for support by Earthwatch up to 100 significant projects each year in the sciences and humanities. Current priorities for support include volcanology, climatology, glaciology, oceanography, and research in Latin America (especially that which illuminates interdependencies between North and South America).

The next deadline for proposals is April 15, 1983. For application guidelines and a list of currently supported projects, contact Sara Bennett, Assistant Director, The Center for Field Research, 10 Juniper Road, Box 127, Belmont, MA 02178 (telephone: 617-489-3030).

Among the projects that have been approved for support for 1983–1984 are a geological study of barrier island migration and erosion; a study of climatic prehistory of Tahiti and Easter Island; an investigation of nearshore circulation around Bermuda; research on plant recovery at Mount St. Helens; an investigation of the implications for the origin of megacrysts and the behavior of basalt magma deep within the earth; and an examination of variable stars as an opportunity to test theories of stellar structure and evolution.

New Geothermal Gradient Data Map

A new, multicolor, geothermal gradient map of the continental United States has been produced as a joint publication of the National Geophysical Data Center (NGDC) and the Los Alamos National Laboratory (LANL). The map, which replaces the 1980 version published by LANL, presents a compilation of more than 1,700 wells that have been measured for temperature at depths greater than 50 m. Temperature/depth profiles are linear or are composed of linear segments reflecting changes in the thermal conductivity of the rocks. The data are displayed on two sheets, one for the east and one for the west, at a scale of 1:2,500,000. The location, depth, and gradient of each well is noted with a single, color-coded symbol. Each well also is numbered and keyed to a table showing latitude, longitude, well depth, gradient, heat flow (where available), thermal conductivity (where available), and a reference.

Cost of each map set is $10 folded or $12 flat. Digital data used to make the map and listed in the table on the map also are available. Output may be obtained on magnetic tape for $200. For additional information, contact the National Geophysical Data Center, NOAA, Code F/GC1, 325 Broadway, Boulder, CO 80303 (telephone: 303-497-6125).

Geophysicists

Helmut E. Landsberg, past president of AGU, received the William F. Petersen Foundation Award 'in recognition of his many scientific contributions to Human Biometeorology.' The gold medal award is made every 3 years to a leading scientist in the field of plant, animal, and human biometeorology. Landsberg is the sixth recipient of the award.

Eric G. Lappala has joined Harding Lawson Associates, consulting geotechnical engineers, as an associate hydrologist. A 13-year veteran of the U.S. Geological Survey, he most recently directed technical investigations for projects involving groundwater contamination in complex aquifer systems in Colorado, Utah, and California.

Kurt W. Riegel has been appointed the head of the astronomy centers section in the National Science Foundation's Division of Astronomical Sciences. Previously, he was associate director of the Office of Environmental Engineering and Technology at the Environmental Protection Agency.

Peter Wilkniss, former senior science associate in the office of the NSF director, is the new deputy assistant director of the NSF Directorate for Scientific, Technological, and International Affairs (STIA).

In Memoriam

Mark E. Burgunker, an AGU member since 1951, died March 24, 1982. He was in his late sixties.

New GRL Editors

President Van Allen has appointed an editor-in-chief and five new editors for *Geophysical Research Letters*. To speed the review process, editors from North America, Europe, Asia, and Australia were selected. Manuscripts should be submitted directly to one of the following editors:

James C. G. Walker (Editor-in-Chief), Geophysical Research Letters, 2455 Hayward, Ann Arbor, MI 48109, USA.

Kenneth J. Hsü, Geological Institute E.T.H., Sonneggstrasse 5, Zurich, Switzerland 8006.

Gaston Kockarts, Institut d'Aéronomie Spatiale, 3 Avenue Circulaire, 1180 Bruxelles, Belgium.

Kurt Lambeck, Research School of Earth Sciences, Australian National University, POB 4, Canberra, ACT, Australia 2600.

Tetsuya Sato, Institute for Fusion Theory, Hiroshima University, Hiroshima, 730, Japan.

Rob Van der Voo, Geophysical Research Letters, 2455 Hayward, Ann Arbor, MI 48109, USA.

Books

Earthquake Prediction Techniques: Their Application in Japan

T. Asada (Ed.). University of Tokyo Press, xii + 317 pp., 1982, $34.50.

Reviewed by Carl Kisslinger

Japan is serious about solving the earthquake prediction problem. A well-organized and well-funded program of research has been under way for almost 20 years in pursuit of the national goal of protecting the dense population of this earthquake-prone country through reliable predictions.

This rather amazing book, edited by Toshi Asada, retired director of the Geophysical Institute of the University of Tokyo, has been written by 10 scientists, each of whom has made important contributions to earthquake science, but who have not been known in the past as principal spokesmen for the Japanese earthquake prediction program. The result is a combination of a very readable tutorial presentation of basic earthquake science that will make the book understandable to the nonspecialist, a good summary of Japanese data and research conclusions, and a bare-knuckles appraisal of current philosophy and strategy for prediction in Japan.

The book is logically organized so that 12 independent chapters by 10 authors result in a coherent treatment of the subject. Disagreements between authors show up; it would be strange if they did not exist in the present state of knowledge of prediction. It is refreshingly clear that no attempt was made to smooth away the rough spots.

The tone is set in Asada's preface: 'Although there are several good books on earthquake prediction, they all have one drawback. Due to the way the material is presented, the reader can easily come away thinking that earthquake prediction is a *fait accompli*, that there are only a few problems that remain unsolved.' Concern about an accurate appraisal of what is now possible and what is likely to be possible within the next few years with regard to reliable predictions is especially great in a country that has on its books a remarkable piece of legislation, the Large-Scale Earthquake Countermeasures Act of 1978. This act assumes that earthquakes are predictable and that predictions of damaging earthquakes, with concomitant social impact, may be issued in the near future.

The book is organized in four parts: 'Earthquakes Repeat Themselves,' 'Long-Range Precursors,' 'Short-Term Precursory Phenomena,' and 'The Road to Actual Earthquake Prediction.' The first part starts with a brief history by Asada of the development of seismology in Japan. Usami provides a manual of good practice in using historical documents for learning about pre-instrumental earthquakes as he summarizes knowledge of ancient Japanese earthquakes. He emphasizes the patterns of repetition of great earthquakes within the distinct seismogenic zones of Japan and the implications for identifying the sites of future ones.

Matsuda's chapter, 'Earthquake Scars,' brings the methods of geological field studies to bear on the derivation of the history of movement on Japanese faults. Presenting empirical relations between maximum fault slip and magnitude and fault length and magnitude, he proceeds to the prediction of earthquake recurrence intervals from geological data. He confronts the problem of agreeing on a definition of an 'active' fault, and he presents the classification of active faults in Japan into three groups, depending on the mean annual rate of slip. Tables with data about many of the best known Japanese faults and of the major earthquakes associated with these are included.

I was perplexed to find in this chapter the first of several references in the book to 'the' Matsushiro earthquake, given once as in 1966, again as '1965-'. The event involved is, of course, the great earthquake swarm of 1965–67, during which over 700,000 earthquakes occurred. The discussion will be baffling to the reader who is not familiar with all of this. The statement on p. 33 that, 'The Matsushiro earthquake is the smallest . . . to have left behind visible earthquake faults on the land surface of Japan' is misleading in that, though the largest event in the swarm had a magnitude less than 5.5, the magnitude equivalent of the total energy release was close to 6.5.

Long-range precursors are sought as a means of identifying places at which the earthquake hazard, as revealed by the historical and geological studies, appears to be substantially enhanced at the moment, and where intensified observations capable of revealing short-term precursory behavior are justified. Temporal and spatial patterns of seismicity can provide guidance to such places. Takagi's chapter on the occurrence of small earthquakes describes this approach and convincingly demonstrates the valuable information provided by the monitoring of microearthquakes with dense regional networks.

Unfortunately, the dual use of the term 'seismic gap,' entrenched in Japan, is perpetuated here. Some of the statements including this term are ambiguous if not misleading. Mogi clearly defined gaps of the 'first and second kind,' to distinguish between a portion of a seismic zone within which no *great* earthquake has happened in a long time and a portion of a seismic zone within which the rate of occurrence of *moderate to small* earthquakes is abnormally low. The qualifying phrase is often dropped in Japanese texts. It is preferable to substitute a term like 'zone of quiescence' for 'gap of the second kind'. Onset of quiescence may be a precursor; the existence of a gap (of the first kind) is not.

Yoshii's discussion of precursory variations in seismic velocity is not a research paper but a thoughtful discourse on the sources of error in every method available for measuring velocity and the difficulties in detecting real changes. He reviews briefly and criticizes all methods except the use of mechanical vibrators of the kind used in reflection seismic exploration. Some fundamental concepts, such as the value of multidirectional velocity measurements to detect anisotropy associated with dilatancy and possible effects of attenuation-induced dispersion on very high precision body-wave velocity measurements, are neglected.

Detection of crustal deformation (as evidence of accumulating strain) by repeated geodetic surveys and other techniques has been a cornerstone of the Japanese prediction strategy from the beginning. Sato reviews this subject in terms of long-term prediction. After summarizing a number of case histories, he says on p. 125 that, 'In my experience there are far more cases in which no link is found between ground uplift and earthquakes than there are cases in which there is a link.' Even this highly regarded approach fails to produce the ideal precursor that has been sought in vain.

As in all of the data-oriented papers in this volume, Sato reviews the sources of error in this technique. He does not mention the debate over the reality of the Palmdale uplift in this country in his discussion of leveling errors. This may be because, though the book carries a 1982 publication date, the original Japanese version appears to have been written about 1978, with only minor updating for the translation.

Continuous observations of crustal movement (psychiro) follows logically as the first chapter in the section on short-term precursors. Although observations with extensometers and tilt meters are included, most of the chapter is devoted to the borehole volumetric strain meter. Anyone who has seen the banks of recorders in the prediction center at the Japan Meteorological Agency, linked by telemetry to a great network of these devices, will not be surprised by the amount of attention given to these observations. Clearly, Japanese specialists expect to see a pattern of short-term changes in strain as one indicator of an imminent earthquake. This ingenious instrument has been largely ignored in this country even though it was developed here.

Changes in level and chemical composition of groundwater (Wakita) and precursory electromagnetic phenomena (Mizutani), including resistivity changes in the ground and geomagnetic variations, are covered in the last two chapters on precursors. Wakita offers a comprehensive summary of Japanese work on hydrological precursors and a table of 113 case histories. His background discussion of precursory radon concentration changes will be helpful for those not familiar with the ideas. He gives a realistic appraisal of the future of geochemical prediction methods.

Mizutani reviews reported precursors in the general category of electromagnetic phenomena. He concludes that reported values of precursory geomagnetic variations have become smaller since the introduction of proton-precession magnetometers, because of the greater stability of these instruments. Another interpretation of the data he offers, backed up by other field and laboratory studies, is that the total magnetic field measured by the proton-precession instrument may very well be the wrong thing to observe for this purpose. If the primary effect of high strain in crustal rocks is to rotate the magnetization vector with little change in total intensity, one ought to measure orthogonal components of the field, or declination and inclination. Mizutani's own very interesting work on the electrokinetic effects of water flowing in cracked rocks is briefly reviewed.

The final section of the book addresses the application of all of this science to the real prediction of destructive earthquakes. Ishibashi is harshly critical of the present Japanese strategy, mostly because he has no faith in the evidence for magnitude-dependent precursor times, and offers his own approach. Space does not permit a thorough review of this iconoclastic blast, but it makes good reading. Takagi offers his own flow chart for reaching a prediction decision based on the evaluation of short-term phenomena. Usami concludes the book with a history of Japanese prediction research from 'The Blueprint' of 1962 to the time of writing. Many interesting facts are given, including the significant action of dropping the word 'research' from the title 'Earthquake Prediction Research Project' after the first five years. We in the United States have held on to that word firmly, emphasizing that the work we are doing is research to learn how to predict earthquakes, not the prediction of earthquakes.

The book is very nicely produced, with good paper, figures, tables, etc. There is a small problem with the translation. Although the translator is obviously a professional with an excellent command of English, and the language is not only fluent but poetic in places, there are numerous examples of nonstandard usage and colinges. 'A telemeter' is a generic term for any sensor, the output of which is telemetered. 'Lateralation' means the distance between points in a geodetic survey. 'Deterioration' of the crust may mean the formation of microcracks at high stress levels. Most of these expressions do not in any way interfere with understanding, and the use of colloquialisms, such as 'budget-buster' (the prediction budget?), enlivens the text.

There are a number of technical points that I would fuss about with the authors. Given the state of our understanding of earthquake physics and prediction, every knowledgeable reader will probably have his own set of these. Some omissions, such as in situ stress measurements and space-geodetic techniques for monitoring localized crustal deformation, are regrettable, but the book is intended to reflect what is going on in Japan, not world-wide.

Those who have engaged in the lengthy and heated debates in our own country about the best directions for our prediction efforts will find this book fun to read as it pierces the serene outer surface of the Japanese scientific community. More important, there are lessons to be learned from those in the forefront of the world effort in prediction for all who are responsible for planning earthquake research and, eventually, for planning the implementation of a real prediction system.

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Laser Beams in the Atmosphere

V. E. Zuev. Transl. by J. S. Wood, Consultants Bureau, New York, xi + 504 pp., 1982. $75.00.

Reviewed by Kenneth Sassen

There is a growing, interdisciplinary field of research which I prefer to call lidar meteorology. It involves the probing of the atmosphere with laser beams to measure the various physical parameters of concern to atmospheric scientists. When this is done with a high-energy, pulsed laser, that is, with a lidar system, the atmosphere can be monitored at unmatched spatial resolution and at reasonably long distances. Gradually, lidar researchers are venturing from their technologically oriented conferences into the realm of the applied atmospheric sciences—they have lately been seen at conferences devoted to air pollution, atmospheric radiation, cloud physics, and even radar meteorology.

A suitably generalized manual on the various lidar remote sensing techniques and their applications has been long needed to legitimize this field. Such an enterprise should, in my opinion, gather together the requisite knowledge on the propagation of monochromatic radiation through the atmosphere in its many states, summarize the state-of-the-art technologies of lasers and laser signal processing, and then combine this knowledge to show what has been done and can be done with laser beams in the atmosphere. *Laser Beams in the Atmosphere* by V. E. Zuev, Director of the Institute of Atmospheric Optics of the Siberian Branch of the Academy of Science of the USSR, comes close to filling this niche.

The original monograph, apparently published in 1977, has recently been translated by James S. Wood into an easily readable book. Although much of the information contained in the book would be of interest to workers outside the discipline of lidar meteorology, including those involved in laser communications and geodesics and atmospheric radiative transfer in general, it is clear that the material covered in the seven chapters represents the insight of a researcher who has participated in the development of the atmospheric laser probing field. There is presented throughout a good balance of material derived both from theoretical and experimental sources. The numerous references come mainly from the Soviet Union, but key studies from abroad are generally included as well. The reader is thus provided with a rare glimpse into the breadth of work being performed within the Soviet Union, even though a large body of the references will remain obscure to us because they are either untranslated or otherwise difficult to obtain.

The contents of the book can be divided into three areas. The first five chapters competently summarize the factors governing the propagation of laser energy through the atmosphere without stressing a great amount of theoretical development. Chapter 1, Refraction of Light Rays in the Atmosphere, briefly considers an area commonly overlooked in lidar observations but which can be of considerable concern to astronomical and geodesic measurements. In chapter 2, Absorption of Laser Radiation by Atmospheric Gases, methods for overcoming the special problems associated with the quantitative determination of the absorption of highly monochromatic radiation are explored. First, though, the chapter begins with summaries of the basic equations and factors affecting the spectral line shapes after which the origins of the absorption spectra from the pertinent gaseous constituents at the laser frequencies are discussed in a quite understandable manner. Chapter 3, The Scattering of Laser Radiation in the Atmosphere, is an even more comprehensive summary of fundamental scattering theory and experiments. Although the effects of particle non-sphericity are largely overlooked in favor of the more treatable case for spheres, specific attention is given to the physical and scattering characteristics of the clear, hazy, cloudy, and precipitating atmospheres. Chapter 4, the Propagation of Laser Radiation in a Turbulent Atmosphere, and chapter 5, the Nonlinear Effects Associated with the Propagation of Laser Radiation in the Atmosphere complete the discussion of the interaction of the atmosphere and laser beams. Strong theoretical support is presented for these difficult subjects, and there is discussion of significant experimental results which are new to me, such as those in a number of Russian studies assessing the effects of CO_2 laser beam propagation through clouds.

The next major area covered in the book is found in chapter 6, Optical Background Noise in the Atmosphere. It is an appropriate topic to include in a lidar meteorology text, but despite the amount of important information given on the passive optical signal the usefulness of this chapter is limited by the lack of consideration of the additional factors which go into determining the signal-to-noise ratio. Nowhere in this chapter, or in the book for that matter, is discussed the manner in which the scattered laser signals are detected and processed. This points out a general difficulty I have with the book: Little is said about the operating and signal processing characteristics of modern laser systems. It is through an examination of data tables, for example, that the wavelengths of the available laser sources can be most readily determined.

The final and most lengthy chapter, Laser Applications in Atmospheric Research, is an excellent summary of the types of information which can be remotely sensed with lasers. The techniques described include the probing of aerosols and clouds with elastic scattering and depolarization measurements and the monitoring of the atmospheric parameters of state using Raman and laser-spectroscopic approaches, but this is by no means a complete list. The consideration given to the basic approaches to laser signal analysis is quite helpful, and each section is generally introduced by a theoretical discussion of this sort. Numerous experimental results are cited, but unfortunately the list of references is hardly up to date owing to the apparent delay in the translation process. Since especially rapid progress has been made over the past several years in the area of laser field applications, it is in this section that the publication delay is the most regrettable.

In summary, I find *Laser Beams in the Atmosphere* to be a valuable reference book for researchers in the atmospheric remote sensing field. Despite the shortcomings mentioned above there is no other book yet available which compiles such a wealth of information of fundamental concern to the lidar meteorologist.

Kenneth Sassen is with the Department of Meteorology, University of Utah, Salt Lake City.

Geodynamics: Applications of Continuum Physics to Geological Problems

D. L. Turcotte and G. Schubert, John Wiley, New York, ix + 450 pp., $29.95.

Reviewed by Philip England

The authors' intention in this book is to provide a treatment of the physical processes that are responsible for plate tectonics and other geological phenomena in a manner that is accessible to senior undergraduate and graduate students of diverse backgrounds in the physical and earth sciences. To this end, they have divided the subject into eight sections, preceded by a brief introduction to plate tectonics. This is perhaps the least felicitous chapter of the book: Summarizing plate tectonics, its driving mechanism and our knowledge of the inner planets, their satellites, and the Galilean satellites in about 30 pages of text is not a trivial undertaking, and while I have read several far worse attempts, I doubt that this chapter will give a clear idea of geodynamics to, say, the average engineering student. Part of the problem lies in the breathless rush through an immense amount of material, some of which is still in a state of flux, and part lies in the curious organization of the material. It seems strange, for example, to put a section on the structure of the continents after sections on accreting plate margins, subduction, and transform faults and before a discussion of paleomagnetism, plate motion, and triple junctions, and stranger still to make this section principally an introduction to geochronology.

The remaining eight chapters consider (2) stress and strain, (3) elasticity and flexure, (4) heat transfer and gravity, (5) fluid mechanics, (6) rock rheology, (7) faulting, and (8) flow in porous media. The structure of most chapters corresponds to an abbreviated classical sonata form: first the basic principles of the chapter (linear elasticity, Fourier's Law of Heat Conduction, etc.) are introduced, then there is usually a discussion of the means by which the pertinent observations are made, these ideas are then developed through a series of applications that lead up to the major topic of the chapter (e.g., flexure of the oceanic lithosphere in chapter 3; lithosphere and mantle thermal structure in chapter 4; driving mechanisms in chapter 6, mantle convection and thermal history of the earth in chapter 7), sometimes the chapter is terminated with a brief coda on a less general aspect of the subject which has caught the authors' attention.

There is much to be commended in this approach; it leads to familiarity with some analytical tools that are used to approach the dynamics of the earth; the copious use of problems complementary to the text and the clear and detailed exposition of the mathematics (on occasions perhaps too detailed) mean that anyone with second-year undergraduate mathematics should be able to follow the book from beginning to end.

There are, however, distinct drawbacks as well, mainly to do with the balance of text; the average earth science student would, I suspect, prefer rather more discussion of the physical principles and rather less mathematics than are found in most of these chapters. Although the progression of applications within each chapter is carefully chosen to lead the student through the concepts necessary to understand the major processes in geodynamics as we know them, there is too little time spent on these processes themselves. For example, the chapter on fluid mechanics is 50 pages long, yet it contains only three pages on the forces that drive plate motion (compared with five on Stokes flow). The discussion of post glacial rebound in this chapter has a clear treatment of the response of a semi-infinite, viscous half space to harmonic loads, but gives barely any discussion of the constraints on mantle viscosity which have been inferred from rebound studies.

There are a few areas that are not treated adequately: seismology is mentioned seven times in the book (six times in passing, including once in the preface where it is acknowledged that the lacuna exists). It is quite true, as the authors state, that a full treatment of seismology would unduly lengthen an already long book, but a brief mention of the information that focal mechanism solutions have given us would not seem inappropriate in a textbook on geodynamics. Indeed, the observational basis for much of the subject is given less weight than we might expect. Other aspects of the subject will doubtless appear to different people to have been given less than their due, but it would be a brave person who would claim to have a perfectly balanced view of a subject that is evolving as rapidly as geodynamics.

In summary, many people will want this book because it collects a lot of material that is useful to the graduate and undergraduate student, as well as to the professional, but the key to the substance of this book lies in its title rather than in its title.

Philip England is at the Department of Geological Sciences, Harvard University, Hoffman Laboratory, Cambridge, Mass.

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Washington, D. C. 20009

Cover. A large fumarole field discovered in 1980 E-SE of Makushin Volcano on Unalaska Island, Alaska. Makushin Volcano, shrouded by clouds, can barely be seen at top right of the photo. Five fumarole fields, all roughly aligned along a suspected N50°E rift zone as marked by several large centers of recent basaltic extrusion, were examined. The field shown is about 1 km long and up to 0.4 km wide. This photo was made on August 9, 1980 (the day of the fumarole-field discovery), during geological field-mapping investigations of Unalaska Island; such studies are being conducted as part of the Geothermal Program in the Division of Geological and Geophysical Surveys of Alaska's Department of Natural Resources. (Photo made and contributed by John W. Reeder.)

Would you like to be on the cover of *Eos*? Do you have photographs (preferably black and white) of geophysical phenomena? Or of unusual experimental results or graphs and charts with both aesthetic charm and scientific interest? *Eos* would like to consider them for publication on the cover. Send your favorite photo with a short (50-200 words) explanation that can serve as a caption, or you may submit a more extensive news item or even a short article to accompany a proposed cover. Captions will be by-lined. If the material has been previously published, please supply a copyright release from the original publisher. Send to *Eos* Cover, AGU Publications Office, 2000 Florida Avenue, N.W., Washington, DC 20009.

New Publications

Items listed in New Publications can be ordered directly from the publisher; they are not available through AGU.

Inertial Rapid Geodetic Survey System (RGSS) Error Models and Network Adjustment, J. Haunab, Final Report, Part II, Report 332, Ohio State University, Columbus, vii + 104 pp., 1982.

Irrigation Economics in Poor Countries, Illustrated by the Usangu Plains of Tanzania, A. Hazlewood and I. Livingstone, Pergamon, New York, viii + 144 pp., 1982, $25.

Komatiites, N. T. Arndt and E. G. Nisbet (eds.), George Allen & Unwin, Boston, xvii + 526 pp., 1982, $75.

Mathematical Modelling of the Behavior of the Lacoste and Romberg "G" Gravity Meter for Use in Gravity Network Adjustments and Data Analysis, L. A. Krieg, Report 321 (AFL-TR-81-0330), Ohio State University Department of Geodetic Science and Surveying, Columbus, xii + 172 pp., 1981.

Negev: Land, Water, and Life in a Desert Environment, D. Hillel, Praeger, New York, xx + 270 pp., 1982.

Oceanography: The Present and Future, P. G. Brewer (ed.), Springer-Verlag, New York, xii + 392 pp., 1983.

Problems of The Arctic and the Antarctic Collection of Articles, vols. 39, 50, 52, 54, A. F. Treshnikov (ed.-in-chief), translated from Russian, available from National Technical Information Service, Springfield, Va., 1982.

Proceedings of the Fourth Symposium on Coordinated Observations of the Ionosphere and the Magnetosphere in the Polar Regions, T. Nagata (ed.), Memoirs of National Institute of Polar Research Special Issue No. 22, National Institute of Polar Research, Tokyo, 1982.

Seismic Migration: Imaging of Acoustic Energy by Wave Field Extrapolation, A., Theoretical Aspects, A. J. Berkhout, *Developments in Solid Earth Geophysics*, vol. 14A, Elsevier, New York, xiv + 351 pp., 1982, $59.50.

Summary of the Results from the OSU Analysis of Seasat Altimeter Data, R. H. Rapp, Report 335, Ohio State University Department of Geodetic Science and Surveying, Columbus, v + 19 pp., 1982.

Classified

Rates Per Line:

Positions Wanted First insertion $1.75 additional insertions $1.50 ***Positions Available, Services, Supplies, Courses, and Announcements*** First insertion $3.50 additional insertions $2.75 ***Student Opportunities*** First insertion, not otherwise announced, free. Additional insertions $1.50.

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Replies to ads with box numbers should be addressed to Box ——, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, D.C. 20009.

For further information or to place an ad call toll free 800-424-2488 or 462-6903 in the Washington, D.C. area.

POSITIONS AVAILABLE

Position in Petrology/Rice University, Houston, Texas. The Department of Geology has a tenure-track opening beginning July 1983 with starting level of appointment depending on the experience of the candidate. The faculty member is expected to establish, or continue a vigorous research program in petrology and to participate in teaching in mineralogy-petrology. Research areas in which we are potentially interested include: igneous petrology, metamorphic petrology, ore deposition, experimental petrology, interactions of fluids with rocks and sediments, isotope geochemistry, but other specialties are not excluded from consideration. Available research facilities of the Department include: electron-microprobe, ICP-spectrograph, Ar-Ar dating, and stable light isotope mass-spectrometry. Send curriculum vitae, a statement of planned research, and names of at least three references to Dr. A. W. Bally, Chairman, Department of Geology, Rice University, P.O. Box 1892, Houston, Texas 77251.

Rice is an equal opportunity employer.

Assistant Research Oceanographer/SIO. The Ocean Research Division at Scripps Institution of Oceanography invites physical oceanographers to apply for a position as Assistant Research Oceanographer, the research equivalent of Assistant Professor (Ph.D. or equivalent degree required) to study contour flow over ocean bottom topography. Candidate must have knowledge of 0 numerical simulation of fluid flow, in statistical turbulence theory. Support is offered for one year. Thereafter, candidate is expected to generate continuing support. Offer is contingent on federal grant approval. Salary range $22,000-$23,800 (commensurate on qualifications). Position start date approximately August 1, 1983. Please send resume and at least three references to Dr. Russ E. Davis, Chairman, Ocean Research Division A030, Scripps Institution of Oceanography, La Jolla, CA 92093 by April 15, 1983. For additional information about the position contact Dr. Richard Salmon (619) 452-2096.

The University of California, San Diego is an Equal Opportunity/Affirmative Action Employer.

Assistant Administrator for Ocean Service and Coastal Zone Management. The National Oceanic and Atmospheric Administration (NOAA) announces Senior Executive Service Vacancy for Assistant Administration for Ocean Services and Coastal Zone Management, location in Washington, D.C. Duties include establishing program policies and goals and the operations of programs of the component units of the National Ocean Service. Pay rate for this SES position commensurate with background and experience; current salary range $56,049-$67,300 per annum. Apply to NOAA/NOS, 6001 Executive Boulevard, Rockville, Maryland 20852, ATTN: PER15 MAIT. Applications must be received by April 22, 1983 to be considered. Equal Opportunity Employer.

Upper Ocean Physical Modeller. A postdoctoral position in upper ocean equatorial modelling supported by NSF is available in the Meteorle Air-Sea Interaction Group at the Florida State University. Minimum salary is $21,000/yr. Qualified Ph.D. should send vita and names of 3 references to Professor James J. O'Brien, The Florida State University, Tallahassee, FL 32306, or call (904) 644-4581.

Assistant Administrator for Oceanic and Atmospheric Research. The Office of Oceanic and Atmospheric Research (OAR), National Oceanic and Atmospheric Administration (NOAA), has announced the vacancy of Assistant Administrator for Oceanic and Atmospheric Research, located in Rockville, Maryland. The Office of Oceanic and Atmospheric Research is responsible for an integrated NOAA oceanic and atmospheric research and development program. The program consists of laboratory and extramural research projects that are relevant to NOAA service and resource management programs, and that provide sound technological and scientific principles on which to base improvements of those services and products. The Assistant Administrator is responsible for the direction and administration of all activities within OAR including the management of a coordinated research program that will ensure OAR's compatibility and effectiveness in serving NOAA's programmatic needs. Incumbent is responsible for effecting a research program in support of NOAA services including cognizance over all agency research, management of in-house non-fisheries laboratories, and maintenance of a balanced, externally conducted, research and development program which complements in-house research efforts. The Assistant Administrator promotes the transfer of research results and new technology to other components of NOAA and, as appropriate, to scientific organizations outside NOAA. He/she advises the Administrator on the need for and efficiency of NOAA's total research and technology development effort. QUALIFICATIONS: This is an exciting and challenging opportunity for an individual with demonstrated knowledge of (1) oceanographic, meteorological, environmental, physical and/or engineering sciences (including at least 24 semester hours in physical science and/or closely related engineering science at the college level). Experience in direction and administration of programs in research and development in the field of oceanic and atmospheric science is required. SALARY: This position will be filled under the Senior Executive Service (SES). Salary could range from $56,915 to $67,300 per annum. APPLICATION: Interested persons should call the NOAA Headquarters Personnel Section, 301-443-8373, to receive a copy of the complete vacancy announcement and qualification requirements. Applicants must also send a U.S. Standard Form 171, Personal Qualifications Statement, to Mrs. Susan D. Cisar, Personnel Management Specialist, Headquarters Personnel Section, ATTPER11, NOAA, 6001 Executive Boulevard, Rockville, Maryland 20852 by April 22, 1983. The Department of Commerce, National Oceanic and Atmospheric Administration is an equal opportunity employer.

Jet Propulsion Laboratory/Experimenter. Ph.D. with three to five years experience in oceanography, physical oceanography, or remote sensing. Excellent communications skills and ability to organize joint experiments with outside investigators. Requires some experience with both in situ data collection (particularly currents) and remote sensing data analysis. Some knowledge of numerical modelling. Will assist with planning and execution of experiments to verify satellite altimetry.

Please call Phillip S. Callahan at (213) 354-4755 or submit resume to Professional Staffing, Department 189.

Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive
Pasadena, CA 91109.
An Equal Opportunity Employer M/F

Geophysicists. The Institute of Geophysics and Planetary Physics, Scripps Institution of Oceanography, has an opening in the Assistant Research series (I-III) for an individual specializing in geophysical instrumentation pertaining to the absolute measurement of gravity. Candidate should have a demonstrated capability in laser metrology, precision time measurements and real time data acquisition and analysis. In addition, the candidate will be expected to perform field measurement with a free-fall absolute gravity meter. Rank and salary are commensurate with qualifications. Send resume, bibliography, brief statement of research interest and experience, and the names of three references to:

Prof. Freeman Gilbert, Assoc. Director
IGPP, A-025
University of California, San Diego
La Jolla, CA 92093

The University of California, San Diego, is an equal opportunity/affirmative action employer. Deadline for application is May 31, 1983.

Faculty Positions/The University of Iowa. The Department of Physics and Astronomy anticipates one or two openings for tenure-track assistant professors or visiting professors of any rank in August 1983. Preference will be given to experimentalists in any area for the tenure-track positions. Current research interests include astronomy, atomic, condensed matter, elementary particle, laser, nuclear, plasma, and space physics. The positions involve undergraduate and graduate teaching, guidance of research students, and personal research. Interested persons should send a resumé and a statement of research interests, and have three letters of recommendation sent to *Search Committee, Department of Physics and Astronomy, The University of Iowa, Iowa City, IA 52242.*

The University of Iowa is an equal opportunity/affirmative action employer.

Economic Geology/Geophysics. George Mason University seeks an economic geologist/geophysicist or structural geologist with geophysical training. The position is at the Assistant Professor level, tenure track, and will begin in September 1983. A Ph.D. is required, and the salary is competitive. GMU's Department of Geology is newly established, and the geology facilities are generous, with modern lab space, ample teaching supplies, equipment for teaching and research, and in-house research support. GMU is located within 20 km of the Carnegie Institution, Smithsonian Institution and many federal agencies of Washington, D.C. such as the USA National Center. Geologically, GMU is located in the Piedmont Province of the Appalachians, in close proximity to the Coastal Plain, Triassic Basin, Blue Ridge, Valley and Ridge and Appalachian Plateau Provinces. If interested, send your vita, a statement of your research interest and teaching interests, and the names of five people who know your professional abilities to: Douglas Mose, Chairman, Department of Geology, George Mason University, Fairfax, Virginia 22030. AA/EOE.

Geophysicist. The Air Force Technical Applications Center (AFTAC) is seeking candidates for a staff geophysicist to supervise research in nuclear test detection seismology and hydroacoustics. Duties include in-house research on discrimination between earthquakes and explosions, technical supervision of contractor research and advising management in the candidate's area of expertise. AFTAC is located at Patrick AFB, Florida. Grade level GS-1515-13, salary $34,050. Send a current SF 171 by March 31, 1983 to Huntsville Area Office, Office of Personnel Management, Southerland Bldg., 806 Governors Drive, S.W., Huntsville, AL 35801. For more information, call C. Thirlwell (305) 494-7663. Equal Opportunity Employer.

Unusual opportunity for Ph.D. Hydrologist. Tarleton State University, part of the Texas A&M University System, has been authorized to offer a B.S. Degree in Hydrology beginning with the Fall 1983 Semester. This will be the only such degree in the state of Texas and one of very few in the nation. The program will be administered by a Director in conjunction with an advisory board of outstanding professionals. The Director we are seeking must be an enthusiastic individual with extensive experience in and knowledge of the field of hydrology to develop this program to regional or national prominence. This will be a tenure-track appointment, rank and salary negotiable, and includes administrative release time. Substantial funding has been awarded for facilities construction.

Applicants should send a resume and the names of three references to: Dr. Thomas G. Hinkson, Head, Department of Physical Sciences, P.O. Box T-69, Tarleton State University, Stephenville, Texas 76402. Telephone 817/968-9143.

The deadline for application is April 15, 1983. Tarleton State University, enrollment 4,300, offers Bachelors and Masters degrees, is located in Stephenville, Texas, a progressive city of 13,000 people, 65 miles southwest of the Dallas-Ft. Worth Metroplex, and is an affirmative action, equal opportunity employer.

Postdoctoral Position in Physical Oceanography. A postdoctoral appointment in physical oceanography will be available beginning September, 1983 in the College of Marine Studies, University of Delaware, Newark, Delaware. The initial appointment will be for one year with probable extension for a second year. The salary will be $20,000-$24,000 per year, depending on experience. Funds for the position will be available largely from a grant by NSF for conduct and analysis of a field observational study of the shelfbreak front in the Middle Atlantic Bight.

The person obtaining the appointment would be responsible for a portion of the planning and execution of the field study, much of the subsequent data analysis and interpretation, and teaching of one graduate level course in physical oceanography each year. The successful applicant must have received the Ph.D. in physical oceanography or a closely related field by the starting date of his appointment. Preference will be given to applicants with direct experience in field observations.

To apply send a complete resume and the names of three references to Professor R. W. Garvine, College of Marine Studies, University of Delaware, Newark, DE 19711. (Telephone: (302) 738-2169).

The University of Delaware is an equal opportunity/affirmative action employer.

Staff Scientists/Systems Analysts. Research and Data Systems, Inc. has openings available for Staff Scientists, Systems Analysts and Programmer/Analysts to work in areas involved in the processing and application of data from satellite based remote sensing systems. Particular needs involve the analysis and processing of Earth Radiation Budget, Microwave, AVHRR and LANDSAT data. Needs also exist in the areas of interactive image graphics, software engineering, realtime processing and satellite data communications. Successful candidates will have an advanced degree in meteorology, physics, engineering, mathematics, or computer science. Hardware background should include IBM, DEC, CYBER or HP-1000 equipment. Send resume in confidence to:

Research and Data Systems, Inc.
10300 Greenbelt Road, Suite 300
Lanham, Maryland 20706
Telephone: (301) 390-6100.

Assistant Professor/University of Alberta. The Department of Physics at the University of Alberta invites applications for a tenure track position at the level of an Assistant Professor in Physics in any of the following areas:

1. Astrophysics and Astronomy;
2. Geophysics (Electromagnetic methods);
3. Theoretical Physics (Medium Energy, Particle Physics, Relativity and Cosmology).

The 1982/83 salary range for an Assistant Professor is $27,720–$39,820 per annum.

Applications will be received until May 1, 1983, and the expected appointment date is July 1, 1983.

The Department of Physics offers both undergraduate and graduate degrees in Physics and Geophysics. The Department currently consists of 47 Faculty Members, 36 Research Associates and Post-Doctoral Fellows and 50 Graduate Students.

Candidates interested in applying should submit a curriculum vitae plus the names of three (3) referees to:

Dr. A. N. Kamal
Chairman
Department of Physics
University of Alberta
Edmonton, Alberta, Canada
T6G 2J1

The University of Alberta is an equal opportunity employer but, in accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada.

The University of Texas at Dallas/Clastic Sedimentology. The Geosciences Program invites applications for a tenure-track opening in clastic sedimentology beginning September 1983 or January 1984. Candidates should have expertise in depositional systems and/or diagenesis of sedimentary rocks. Rank and salary are open and the appointment level will be commensurate with the candidates experience. The position requires a Ph.D. and a strong commitment to excellence in research and teaching. Teaching duties will involve advanced undergraduate and graduate courses, some participation in field courses and supervision of M.S. and Ph.D. research students. Applicants should send a letter outlining specific research interests, a resume (indication of sex and ethnicity for Affirmative Action statistical purposes is requested but not required) and names of three references to:

Academic Search #253
The University of Texas at Dallas
P.O. Box 688
Richardson, TX 75080

Applications should be received by April 30, 1983.

The University of Texas at Dallas is an Affirmative Action/Equal Opportunity Employer.

Chairman—Department of Geological Sciences, Wright State University. The Department of Geological Sciences, invites applications for the position of chairman, to be appointed September 1984. We seek a dynamic individual with administrative talent and an appreciation for research and practice-related educational activities. Rank is at the full professor level and no restrictions have been placed on areas of specialization. The department is active with 12 faculty and an emphasis on professional practice, yet maintaining a firm commitment to basic research.

Send a letter of application, curriculum vitae and names of three references to:

Chairman, Search Committee
Department of Geological Sciences
Wright State University
Dayton, OH 45435.

Wright State University is an affirmative action/equal opportunity employer. Closing date for the position is October 31, 1983.

Conference

FUNDAMENTAL MAGNETOSPHERIC PROCESSES IN THE PLASMAPAUSE REGION

October 25–27, 1983

The University of Alabama in Huntsville
and
NASA/Marshall Space Flight Center
Huntsville, Alabama

Conveners: J. L. Horwitz and J. L. Green

This conference is designed for experimentalists and theorists concerned with wave and plasma processes in the vicinity of the plasmapause. Appropriate topics for papers to be presented will include: wave phenomena associated with the plasmapause; sources and loss of cold and warm plasmas near the plasmapause, plasmasphere filling; identification, structure, formation and dynamics of the plasmapause, relationship of plasmapause to other important magnetospheric boundaries. Attendance will be limited. Persons wishing to present papers should send an abstract (use convention for AGU meeting abstracts) to one of the conveners by July 9, 1983. Information on hotel accommodations will be provided on request

Dr. J. L. Horwitz
Department of Physics
The University of Alabama in Huntsville
Huntsville, AL 35899
205/895-6276/453-0505.

Dr. J. L. Green
Magnetospheric Physics Branch/ES53
Space Sciences Laboratory
Marshall Space Flight Center
MSFC, AL 35812
205/453-0028.

RESEARCH IN SPACE PLASMA PHYSICS

MIT's Center for Space Research invites applications from qualified scientists for the following positions in its Space Plasma Group:

Postdoctoral: To perform analysis of data from Voyager plasma experiments. Current work research includes work on interplanetary medium and physics of Jovian and Saturnian magnetospheres. Applicants should have recent degree in relevant field, with strong background in plasma physics and mathematics. Familiarity with latest computer techniques vital. (Job No. R986)

Postdoctoral: To participate in theoretical studies of Earth's magnetosphere and ionosphere. Some interpretation of spacecraft data may be involved. Candidates should have strong background in applied mathematics plus 2 years research experience. Demonstrated capability in theoretical plasma physics vital. (Job No. R987)

Experimental Physicist: To design, evaluate and construct instruments for space missions. Requires PhD plus strong background in Space Plasma Physics or closely related field, along with direct experience in program management and design and construction of space-qualified instruments. Familiarity with neutral and/or ion mass spectrometers preferred. (Job No. R988)

Please submit resume accompanied by publications list and reference to appropriate job number, to: Dr. H.S. Bridge, c/o MIT Personnel Office, E19-239, 77 Massachusetts Avenue, Cambridge, MA 02139. MIT is an equal opportunity/affirmative action employer.

MIT

NATIONAL SCIENCE FOUNDATION

NSF's Division of Civil and Environmental Engineering is seeking qualified candidates for a rotational position in the Earthquake Hazard Mitigation Section to manage the extramural research program in Dynamic Structural Analysis and Design.

It is hoped that this position will be attractive to academic researchers on sabbatical leave.

The position is excepted from the competitive civil service at the GG-14/15 level (equivalent to GS-14/15) $41,277 to $63,115 per annum.

Candidates should have a Ph.D. or equivalent experience in the appropriate field of civil engineering plus six to eight years of successful research experience beyond the Ph.D. A broad knowledge of the field and some administrative experience are also required.

The position will be available in summer 1983. Resumes indicating current salary should be sent to:

National Science Foundation
Personnel Administration Branch
1800 G St. NW., Rm. 212
Washington, DC 20550
Attn: E. Paul Broglio, EX 83-31.

For further information contact 202/357-7841.

NSF is an Equal Opportunity Employer

Postdoctoral Research Associate Positions/Johns Hopkins University, Applied Physics Laboratory. Positions are available for studies of planetary magnetospheres, and for studies of earth magnetospheric and auroral physics. Selected candidates will participate in the analysis and interpretation of data obtained from deep space probes (Voyager), or particle, field, and atmospheric emissions data from earth orbiting spacecraft. Positions are one year renewable opportunities with flexible starting dates. Applications should be addressed to Mr. Stevan F. Sayre, Department LER-258, The Johns Hopkins University, Applied Physics Laboratory, Johns Hopkins Road, Laurel, MD 20707.

An Equal Opportunity Employer M/F.

SERVICES, SUPPLIES, COURSES, AND ANNOUNCEMENTS

May 9–13, 1983. "Planning, Design, and Operation of Real-Time Data Monitoring Systems and Applications." $750.00. Topics include remote-site sensors and telemetry equipment, communications systems options (satellite, radio line-of-sight, telephone, etc.), data collection platforms, computer systems software, data base design and management, applications that include flood control, irrigation, hydropower production, hydrological and meteorological data collection, water quality, air pollution, acid rain, groundwater levels and quality, etc., economics of real-time data collection, use of radar information, current status of hardware, computer graphics and computer imagery for remote sensing. For additional information, contact Dr. Raul S. McQuivey, Sutron Corporation, 11150 Main Street, Fairfax, Virginia (703) 591-8910.

"Advances in Stormwater Management" at The Pennsylvania State University, May 18–20, 1983. For more information call David Wall, (814) 863-2634, The Pennsylvania State University, 215 Sackett Building, University Park, PA 16802.

STUDENT OPPORTUNITIES

Graduate Research Assistantships in Earthquake and Exploration Seismology/University of Kansas. The computer acquisition of digital seismograms for a 20 + station seismic network covering the southern end of the Central North American Rift System and the development of techniques for Very High Frequency (500-1000 Hz) reflection seismology provide excellent opportunities for graduate study at the M.S. or Ph.D. level. For further information and/or application, please write or call:

Dr. George H. Roshe, Chairman, Geophysics Program
Department of Geology, University of Kansas
Lawrence, Kansas 66045 (913) 864-4971

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AGU

Tectonics— One Year Later

In its first year *Tectonics* was a smashing success. It surpassed all standard projections for a new journal. Changes are in store for 1983 that will make *Tectonics* an even more attractive place for geologists and geophysicists to publish their work.

In June 1981 the AGU Council approved the creation of *Tectonics*, a journal devoted to a narrowly defined area of geophysics. Eight years had passed since AGU had created its last new journal, *Geophysical Research Letters*. During those years, the Council members and Publications Committee members had wrestled with the complex problems of how best to serve the evolving information needs of the membership and how to respond to criticisms of the current journals program.

It was decided that the best way to solve the problems and to also face the growing competition to the journals was to meet challenges head on. A new journal would be started.

Starting a new journal is a major commitment, not to be undertaken lightly. The new publication would be a specialty journal with a limited number of printed pages per year. There would be no page charges; as a result, subscription rates would necessarily be higher per page than for the *Journal of Geophysical Research* (JGR) since there would be no other source of financial support. It was also decided that the journal would have a truly international focus, like the branch of science it was developed to serve. A joint publishing agreement was struck with the European Geophysical Society, and an editor for Europe and one for North America were appointed to serve with the Editor-in-Chief.

The official go-ahead came on May 24, 1981, with the first issue of *Tectonics* scheduled to be mailed in February 1982. This is an extraordinarily short lead time for beginning a new journal and *Tectonics* suffered some growing pains as a result.

Despite the hurried preparations, year 1 was marked by significant successes. Member response was particularly gratifying, with more than twice the projected subscriptions being placed. Library subscriptions met the modest amount budgeted for them. We know that many libraries had already committed their 1982 subscription budget before they received announcements of *Tectonics*. More library subscriptions are needed to provide the level of acceptance we expect for an AGU journal, and staff is committed to developing this subscription base.

The short lead time for the first issue and the field schedules of many potential authors created difficulties with the manuscript flow. Despite these factors the number of pages printed in the first year was within 5% of the projected page budget. International representation among the authors was a primary objective; year 1 found 7 countries represented in the list of authors of the 31 articles.

Another objective was speed of publication. The median time from acceptance of papers to the actual mailing of printed issues was 12 to 14 weeks. With a more steady manuscript flow this range can be trimmed. The production time for *Tectonics* in 1982 was actually faster than for JGR.

We cannot overlook nuances as another measure of success. The proposal for this journal called for breakeven by year 3, the standard for commercial and university presses at that time. Today these publishers are considering breakeven in year 5 to be a satisfactory position for a new journal. We reached breakeven on direct expenses in year 1. This is a very successful financial position for a new venture, particularly one with a single income source.

Looking ahead to year 2 the editors and staff have changed some features to make *Tectonics* an even more attractive medium for publication. Longer manuscripts are clearly in the offing for this journal, but without page charge support the total number of pages cannot simply be adjusted upward to allow for these longer papers. Therefore, to accommodate these papers, the trim size will be enlarged to that of JGR to provide more words per page.

Those involved in tectonic research require maps and oversized figures to adequately convey the science; these maps and figures will be printed in *Tectonics*, and the larger trim size will allow us to handle them more satisfactorily. Also, when necessary, either foldouts or maps in a pocket will be included, the additional costs for which must be defrayed by support from the authors' institutions.

Critics of the *Tectonics* proposal were concerned about the scientific scope of the journal. *Tectonics* is carving out a niche for itself different from that of JGR. Some evolution in the original statement of editorial scope is expected as the journal matures. It is clear that the research *Tectonics* is designed to convey is in fact being done. More and more projects that represent a true melding of traditional geology and geophysics are under way. These papers are ideal for *Tectonics*.

As we review year 1, we are well pleased with the successes our fledgling journal has made. We have learned much from this year and we look forward to the reaction of authors and readers to the changes introduced for year 2.

Judy C. Holoviak
Director of Publications

JGR Red Slates Special Issue

The red-covered section of the *Journal of Geophysical Research* (JGR) is planning a special issue in recognition of Tom Crough's outstanding contributions to solid earth geophysics. An August 1, 1983, deadline has been set for submission of papers to this issue. Anyone desiring to contribute a paper on a subject closely related to Tom Crough's research interests should notify JGR Red Editor Gerald Schubert by letter, stating a tentative title or research topic and estimated date of manuscript submission. Send correspondence to

Gerald Schubert
Department of Earth and Space Sciences
University of California, Los Angeles
Los Angeles, CA 90024.

Through June 1983 send a duplicate of California correspondence to

Gerald Schubert
Journal of Geophysical Research
Geology Department
The Hebrew University of Jerusalem
Jerusalem, Israel.

Membership Applications Received

Applications for membership have been received from the following individuals. The letter after the name denotes the proposed primary section affiliation; the letter A denotes the Atmospheric Sciences section, which was formerly the Meteorology section.

Regular Member

Philip B. Bedient (H), Steven G. Buchberger (H), Carl M. Bunker (V), Roger W. Burke (O), William H. Busch (O), Daniel Cadet (A), Sandral Daniell (G), Steve Denahan (H), Douglas W. Duncan (T), John C. Gerlach (A), Ernest C. Hauser (T), Bruce B. Hicks (A), Mary C. Hill (H), Donald Jorgensen (H), Randy D. Klein (H).

David C. Lanigan (T), Long C. Lee (A), G. Wesley Lockwood (A), Vicente L. Lopes (H), Gottfried P. Maxerath (A), Carl J. Michelsen (V), Louis Nash (O), Masahiro Osako (T), Stan Owocki (SS), Terry J. Shackelford (T), Ellen D. Smith (H), Charles R. Stern (V), Albert A. Tomko (SA), Philip L. Wagner (V), David C. Woods (A), Thomas Yelin (S), Christos S. Zerefos.

Student Member

Kathleen Ahlenius (V), Obiora Pat Aliboh (H), Roy Burger (S), Leslie Burke, Kevin Campbell, David B. Cook (T), Frederick A. Dube (GP), Lisa G. DuBois (O), Donald S. Dunbar (O), John Eberlin, Daniel James Genoshe (S), Dian Gifford (O), Jodi L. Gouden (P), Karen Gray (V), Randy F. Greb (H), F. Bryan Grigsby (T), Gary E. Hokkanen (H), James A. Howe (G), Dan Jansen (T), Ralph F. Keeling (A), Kevin Kremik (S), Kim Kroeger (G).

Jeffrey Lee (T), David M. Levy (O), Jian Lin (T), Shu-Wang Liu (GP), David G. Livermore (H), Ned T. Marks (H), Osamu Matsubayashi (T), Daniel J. Melendez Alvira (SA), Joseph A. Mihalko (G), Jay P. Mitchell (S), James N. Nmoun (O), Terrance G. Onsager (SM), Jim Rohlove (G), Charles E. Savola (O), Diana Seely (H), Steven F. Siwec (H), Daniel Steinberg (SS), Jack Walker (G), Chuching Wang (H), B. Kevin Wood (V).

Associate Member

Joaquin Ruiz (V), Thomas J. Suchoski (H).

AGU Congressional Science Fellowship

The individual selected will spend a year on the staff of a congressional committee or a House or Senate member, advising on a wide range of scientific issues as they pertain to public policy questions.

Prospective applicants should have a broad background in science and be articulate, literate, flexible, and able to work well with people from diverse professional backgrounds. Prior experience in public policy is not necessary, although such experience and/or a demonstrable interest in applying science to the solution of public problems is desirable.

The fellowship carries with it a stipend of up to $27,000, plus travel allowance.

Interested candidates should submit a letter of intent, a curriculum vitae, and three letters of recommendation to AGU. For further details, write or call Member Programs Division, Congressional Fellowship Program, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, D.C. 20009 (telephone: 462-6903 or 800-424-2488 outside the Washington, D.C. area).

Deadline: March 31, 1983

Meetings

Announcements

Gordon Research Conferences

Six of the 107 Gordon Research Conferences scheduled for June 13 to August 26, 1983, in New Hampshire should be of interest to geophysicists. 'Dynamics of Gas-Surface Interactions' is planned for August 1–5 at the Plymouth State College (North); 'Environmental Sciences: Air Biogeochemical Cycles and the Atmosphere' is slated for June 20–24 at the New Hampton School in New Hampton; 'Space Plasma Physics' (subtitled 'Outstanding Problems in the Magnetosphere-Ionosphere-Atmosphere System') will be held June 13–17 at the Plymouth State College (South) in Plymouth; 'Inorganic Geochemistry' (subtitled Quantification of Petrologic Processes) is slated for August 22–26 at the Holderness School in Plymouth; 'Flow in Permeable Media: Physics and Chemistry' is planned for July 25–29 at the Tilton School in Tilton; and 'Molten Salts and Metals' is slated for August 22–26 at the Brewster Academy in Wolfeboro.

The Gordon Research Conferences, begun 52 years ago, state as their exclusive purpose the fostering and promoting of education and science through the free and informal exchange of ideas among participants. The complete program for the 1983 Gordon Research Conferences is published in *Science*, March 4, 1983.

Interested persons seeking applications and additional information should contact Alexander M. Cruickshank, Director, Gordon Research Conferences, University of Rhode Island, Kingston, RI 02881 (telephone: 401-783-4011 or 783-3372). Attendance at each conference is limited to 100 participants, so early registration is encouraged. Mail for the office of the Director from June 13 to August 26 should be forwarded to Colby-Sawyer College, New London, NH 03257 (telephone: 603-526-2870).

Lake Superior Geology

The 29th Annual Meeting of the Institute on Lake Superior Geology will be held in Houghton, Mich., May 11–15, 1983. All aspects of the geology surrounding Lake Superior will be discussed; special emphasis will be on Precambrian silver and gold mineralization. An award will be made for the best paper written and delivered by a student.

Two field trips also are planned: one to look at the geology of the Keweenaw Peninsula and the other to look at the geology of the Ropes Gold Mine and the Deer Lake peridotite.

Registration forms and additional information may be obtained by writing to the conference chairman, T. J. Bornhorst, Department of Geology and Geological Engineering, Michigan Technological University, Houghton, MI 49931.

Atmospheric Tides

A 1-day workshop on 'Tides in the Mesosphere and Lower Thermosphere' will be held August 17, 1983, at the International Union of Geodesy and Geophysics General Assembly in Hamburg, FRG. The session is targeted at theoreticians, experimenters, and data analysts involved in tides research. Analysis and interpretation of wind measurements recorded during the November 1981 global observational campaign will be the main topic.

For additional information contact Jeffrey M. Forbes, Department of Physics, Boston College, Chestnut Hill, MA 02167 (telephone: 617-969-0100).

Organizers of the workshop are the International Association of Meteorology and Atmospheric Physics (IAMAP) and the ICMUA (IAMAP Commission on Meteorology of the Upper Atmosphere) Working Group on Tides in the Mesosphere and Lower Thermosphere.

Meeting Report

Mechanics of Fluids in Porous Media

Transport of quantities such as mass component of a phase and/or heat occurs in fields as diversified as petroleum reservoir engineering, groundwater hydraulics, soil mechanics, industrial filtration, water purification, wastewater treatment, soil drainage and irrigation, and geothermal energy production. In all these areas, scientists, engineers, and planners make use of mathematical models; these models describe the relevant transport processes that occur within controlled porous medium domains and enable forecasting of the future behavior of these domains in response to planned activities. The mathematical models, in turn, are based on the understanding of phenomena, often within the void space, and on theories that relate these phenomena to measurable quantities.

Because of the pressing needs in areas of practical interest such as the development of groundwater energy storage and geothermal energy production, a vast amount of research in all these fields has contributed, especially in the last two decades, to our understanding and ability to describe transport phenomena in porous media. In recent years these research efforts have been significantly accelerated, attracting scientists from many disciplines. The practical needs of solving boundary value problems in heterogeneous domains, irregular boundaries, coupled phenomena and multiple dependent variables led to the development of a variety of powerful numerical techniques. The realization that fields are highly heterogeneous and that the degree of heterogeneity depends on the scale of the problem led to the introduction of stochastic concepts as an additional tool for the description of phenomena.

A meeting devoted to interdisciplinary consideration of this entire field was convened by J. Bear and M. Y. Corapcioglu under the auspices of a NATO Advanced Study Institute held July 18–27, 1982, at the University of Delaware, Newark. Attended by 85 scientists from 21 countries, the meeting addressed recent advances in research on transport phenomena in porous media, with special emphasis on the frontiers of knowledge in this area and on a unified approach by scientists coming from different disciplines. Lectures covered four main topics: fundamentals of transport processes, porous medium deformation, the stochastic approach, and numerical methods.

The first part of the meeting was devoted

to the development of the fundamental equations of balance of mass, momentum, and energy in a porous medium where the latter is viewed as a continuum. Two methods were presented for obtaining these equations in the case of multiphase (and possibly multicomponent) flow in a (possibly) deformable porous medium: the mixture theory and a theory based on volume averaging. In the latter case, the averaging is over a representative elementary volume of the porous medium, of the equations of balance of the considered extensive quantities, written at the microscopic level, that is, at a point within an individual phase present in the system.

When this approach is applied to the equation describing momentum balance, subject to certain assumptions including low Reynolds number, Darcy's law is obtained. As the Reynolds number is increased, the flow regime changes until full turbulence is reached. This phenomenon—as it actually occurs within the pore space—was demonstrated by using advanced laser monitoring and photographing techniques. Multiphase flow problems were introduced by a discussion on infiltration. The multimedia approach of handling heterogeneities in aquifer systems—applicable to both leaky aquifers as well as to fractured porous media—was demonstrated by considering the hydraulics of wells in heterogeneous porous media.

In the second part of the meeting, theories on porous medium deformability under saturated and unsaturated soil conditions were reviewed, with special attention focused on the subject of consolidation in aquifers. One of the major reviewed topics was Biot's theory, which underlay many of the presentations. Various constitute equations representing nonelastic behavior were presented and discussed. A methodology was presented for dealing with the problem of land subsidence and horizontal displacements which result from pumping from an aquifer.

The usual continuum approach and the macroscopic equations derived by employing it fail to describe transport phenomena when dealing with largescale problems in aquifers; this results from the large variability in transport and storage properties of the considered domains. The solution of transport phenomena in domains with such heterogeneities, which always exist and on which information is available only in statistical forms, requires a special method of treatment—the stochastic approach. Two papers were presented which represent a frontier in research efforts on this important subject.

Once a mathematical model—or a well-posed boundary value problem—is established as a satisfactory representation of a process, its solution for cases of practical interest usually calls for a numerical technique. This is because of the heterogeneity of the domain, the irregularity of its boundries, nonlinearity of the problem, and other factors which preclude the possibility of an analytical solution. Several advanced numerical methods, especially ones involving finite elements, were presented and compared. Of special interest is the conjugate gradient method, which facilitates the treatment of very large problems; it was demonstrated for problems of flow and land subsidence.

A proceedings volume containing the lectures presented at the NATO Advanced Study Institute is in preparation and will be published by Martinus Nijhoff Publishers BV, The Hague, The Netherlands. In the meantime, further details of the meeting may be obtained from either J. Bear or M. Y. Corapcioglu.

This report was prepared by Jacob Bear *of the Department of Civil Engineering, Technion-Israel Institute of Technology, Technion City–Haifa, Israel 32000 and* M. Yavuz Corapcioglu *of the Department of Civil Engineering, University of Delaware, Newark, Delaware 19711.*

Geophysical Year

New Listings

The complete Geophysical Year last appeared in the December 21, 1982, *Eos.*

A boldface meeting title indicates sponsorship or cosponsorship by AGU.

May 11–15, 1983 29th Annual Meeting, Institute on Lake Superior Geology, Houghton, Mich. (T. J. Bornhorst, Department of Geology and Geological Engineering, Michigan Technological University, Houghton, MI 49931.)

June 13–August 26, 1983 Gordon Research Conferences, various sites in New Hampshire. (Alexander M. Cruickshank, Director, Gordon Research Conferences, University of Rhode Island, Kingston, RI 02881; telephone: 401-783-4011 or 783-3372.)

October 31–November 2, 1983 Shuttle Environment and Operations, Washington, D.C. Sponsor, American Institute of Aeronautics and Astronautics. (AIAA, Meeting Department, 1290 Avenue of the Americas, New York, NY 10019)

November 14–17, 1983 Seventh International Symposium on the Scientific Basis for Nuclear Waste Management, Boston, Mass. Sponsor, Materials Research Society. (Gary L. McVay, Materials Department, Battelle Northwest Laboratories, P.O. Box 999, Richland, WA 99352; telephone: 509-375-3762).

November 16–18, 1983 Third Applied Climatology Conference, Hot Springs, Ark. Cosponsors, Committee on Probability and Statistics and Applied Climate Committee of the American Meteorological Society. (Send all abstracts to Wayne M. Wendland, Illinois State Water Survey, P.O. Box 5050, Station A, Champaign, IL 61820.)

Correction

The title of the following meeting has been revised since its listing in the February 8, 1983, *Eos.*

October 3–7, 1983 Chapman Conference on Magnetic Reconnection, Los Alamos National Laboratory, Los Alamos, N.M. (Meetings, AGU, 2000 Florida Avenue, N.W., Washington, DC 20009.)

GAP

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